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Market Assessment on the Potential of Oil Palm Empty Fruit Bunch (OPEFB) Particleboard in Malaysia's Wood-Based Industries

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ABSTRACT

This study was undertaken to assess the market potential and perceptions of oil palm empty fruit bunch (OPEFB) particleboards in Malaysia's wood-based industries, including furniture. The results of the assessments were based on the reasons and opinions raised by the wood-based product manufacturers and users. The assessment was conducted through a survey which involved 300 respondents during Malaysian International Furniture Fair (MIFF) and Malaysian Furniture Exporters Exhibition (MAFEX) in March 2009 with the aims to investigate the manufacturers' and users' awareness and perceptions towards OPEFB particleboards as an industrial material, to identify OPEFB particleboard potential as an input material and to give general recommendations to OPEFB-based manufacturers, particularly particleboards, so as to help them improving their products based on analysis of the product strengths and weaknesses. The survey data obtained from the fair and exhibition were transformed into tabular and graphical forms. A descriptive analysis was performed for the gathered data to make them interpretable. The 'reasons for choosing' data were analysed with respect the Normality Test by using Kolmogrov-Smirnov Test to determine whether the data are normal or not. The data are considered normal if the mean value is greater than 0.5. The survey showed that most of the respondents preferred rubberwood as a better raw material to be used in producing wood-based products compared to OPEFB. This is because promotion on OPEFB is insufficient and should be done more frequently and widely to gain attentions from wood-based product manufacturers.

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INTRODUCTION

The decrease of forest resources supply is causing concern among wood-based product manufacturers. The industry is therefore encouraged to explore potential resources to ensure continuous supply of raw materials. There are many crops discovered to meet the requirements as alternative materials, such as rubberwood, kenaf, *Acacia mangium* and sesenduk (Izran *et al.,*2009a, 2009b, 2009c, 2009d; Paridah *et al.;* 2009; Khairul *et al.,* 2009). Oil palm empty fruit bunch (OPEFB) was also listed as an alternative material and it has been found to be a good alternative to produce value-added products like particleboards and flat board due to its physical properties and demands, rather than to be utilized as fuel (Nasrin *et al.,* 2008). The utilisation of oil palm biomass in the wood-based industry in Malaysia would help the country to overcome a deficit of 3.85 million m^3 of wood, while strengthening its zero-waste policy between 2006 and 2010 (The Star, 2009). Generally, OPEFB is difficult to be accepted by the manufacturers as a raw material for the production of particleboards due to the great competition from solid wood and several obstacles that need to be overcome. These obstacles include the market coverage and the performances of OPEFB-based products themselves, which are mainly on physical and mechanical properties. In order for OPEFB to be successfully used, the government and private sectors need to focus on research and development (R&D) to reveal its potential as an alternative raw material for solid wood. This should be further supported through the development of the industry in an integrated manner, combining potential manufacturing activities and R&D activities (Ismail *et al.,* 2008). There are many research carried out to study the potential of OPEFB (Mohamad, 1995; Ngan, 2005; Ratnasingam & Wagner, 2009).

Hence, this study focused on one of the obstacles, i.e. market coverage, as information regarding this is very limited for OPEFB. The specific objectives of this study were to: 1) assess the acceptance level of the other alternative materials which are very common in producing wood-based products; 2) investigate the perceptions and awareness of the manufacturers towards OPEFB particleboards as an input for furniture; 3) make general recommendations for the OPEFB particleboard manufacturers to increase their awareness towards their product attributes and characteristics; 4) make recommendations related to environmental issues and consumers' perceptions with regards to OPEFB.

MATERIALS AND METHODS

Determining the Most Accepted Material

This was done to determine the most accepted material among manufacturers in producing wood-based products. It was evaluated based on the niche market. A structured questionnaire was prepared to collect information from furniture buyers and manufacturers who had attended the furniture fairs, i.e. Malaysian International

Furniture Fair (MIFF 2009) and Malaysian Furniture Exporters Exhibition (MAFEX). The respondents were chosen randomly, while the questionnaire was given by hand to the Purchasing and Specification Managers of factories which were also selected randomly to avoid biasness. OPEFB-based samples were also presented to them during the 'questionnaire-answering' session to prevent them from giving bias responses. The samples of OPEFB were distributed based on the final products produced by the factories such as the OPEFB-based furniture for furniture manufacturers.

The Questionnaire

The questionnaire was divided into four parts. The first part covered market segmentation as well as the most-accepted materials (Table 1). There were ten characteristics placed under each subject in this part. The second part covered two subjects, namely, acceptance level of the chosen materials and the reasons for choosing those materials. In determining the most accepted material, parameters evaluated were performances, green based resources, low maintenance, and pollution free, aesthetics, availability, alternative material, quality and cost. Only rubberwood and OPEFB were involved in this evaluation. This is because rubberwood is said to be more popular than other wood species among the manufacturers. In fact, rubberwood is the main raw material used for furniture manufacturing in Malaysia. Based on the current situation, however, rubberwood plantations are slowly being converted into oil palm plantations or housing areas, and a shortage in the rubberwood supply is therefore inevitable. The awareness towards OPEFB as a raw material for particleboard and its properties may have made it suitable as an input material, apart from the availability of the material and the environmental issues in Malaysia's wood-based industries; these were included in the third part of the questionnaire. The fourth section was more on the perceptions and opinions raised on OPEFB particleboard. Each subject included in the second to fourth parts was

TABLE 1
Characteristics under market segments and the most-accepted materials

Market Segments	The Most-Accepted Material
Office Furniture	Rubberwood
Wooden Door	Veneer
Home Furniture	Medum Density Fibreboard
Education Table	LVL
Table Set	Oriented Strand Board
Phone Table	Plywood
Cabinet	Hardwood Lumber
Kitchen	Softwood Lumber
Bedroom Set	Edge-Glued Panel
Others	OPEFB Particleboard

measured using Likert scale (rating scale), ranging from 1 to 5. The rates were ranked as shown in Table 2.

TABLE 2
Likert scale used for ranking (second part of the questionnaire)

Rating	Ranks
1	No Knowledge at all
2	Below Average Knowledge
3	Average Knowledge
4	Above Average Knowledge
5	Perfect Knowledge

The first subject of part three, the scale also ranged from 1 to 5, whereby 1 = Not Aware, 3= Aware, 5= High Level of Awareness. In order to evaluate the other three subjects in part three, the scale was also ranked as 1 = Not Important, 3 = Important, and 5 = Very Important. The respondents were allowed to provide more than one ranking for the last three subjects in part three. Seven characteristics were put under each of the three subjects and only 5 characteristics were given in the last subject, i.e. consumers' perceptions (Table 3).

The survey instrument included some general questions at the beginning of each section, while more specific ones were given at the end of the questionnaire. The questions included one on how to attract the interest of the respondents? In the attempt to maintain the respondents' interest, different forms of questions were incorporated in each part of the questionnaire. Most of the questions had a fixed number of categorical responses, but some were open-ended to allow for opinions to emerge. The questions were open-ended, and this was meant to simplify analysis and coding. A briefing on how to answer the questionnaire was carried out before the respondents began answering the questions and they were also allowed to ask questions if they faced any difficulty in comprehending the questions.

TABLE 3
The Characteristics stated by the four subjects in the questionnaire

Awareness on OPEFB Particleboard	OPEFB Particleboard Attributes and availability	Environmental Issues	People's Perceptions
Furniture	Cost	Green Product	Lack of Information
Door	Surface Uniformity and Smoothness	Recycling Waste	Environmental Friendly
Office furniture	Moisture resistance	Deforestation	Low Cost
Cabinet	Veneer and Laminates Adhesion	Pollution Control	Performances
Chair	Screw and Staple-Holding Ability	Reforestation	Cheaper
Table	Tooling	Food and Fuel	
Kitchen	Porosity	Health and Safety	

Data Analysis

To ensure a better understanding of the data, these were summarized into frequency distributions and presented into tabular and graphical forms. A frequency distribution is a display of occurrence of each score value. It is used to compare the percentages of the proportions of the total number of measurements (Ronald, 1982). Descriptive analysis is one series of nominal values of selection to deflect the real value. It also represents relative percentages to summarize the data so as to make them more interpretable. The tables and graphical charts in the form of Microsoft Excel were used to view the trend in this study. The data for the 'reasons of choosing the material' were analyzed with regards to Normality Test by using One-sample Kolmogorov-Smirnov Test to determine whether or not the data for that subject were normal. The mean value of the data should be more than 0.5 to be considered as normal. Correlation Matrix for OPEFB and particleboards was also conducted. This was an additional analysis done to obtain a matrix giving the correlations between all the pairs of data sets.

RESULTS AND DISCUSSION

Visitors' Reasons for Visiting the Fairs

Based on the analysis, 95% of the 300 respondents attended the fairs were manufacturers and 5% were users. Forty seven percent of the manufacturers were from wood-based industries, particularly the panel industries, and the remaining (53%) were furniture manufacturers. Twenty one percent of the manufacturers were among the participants. 300 respondents gave different reasons for attending the fairs, as presented in Table 4.

TABLE 4
Respondents' reasons of attending the fairs

Reasons	Percentage (%)
To know new products in the market	29.8
To place orders	20.23
To build connection and visit suppliers	19.6
Gathering current furniture industry status	14.9
Business opportunity	12.39
To seek representatives for the factories	3.89

The Most Accepted Material and Market Segment

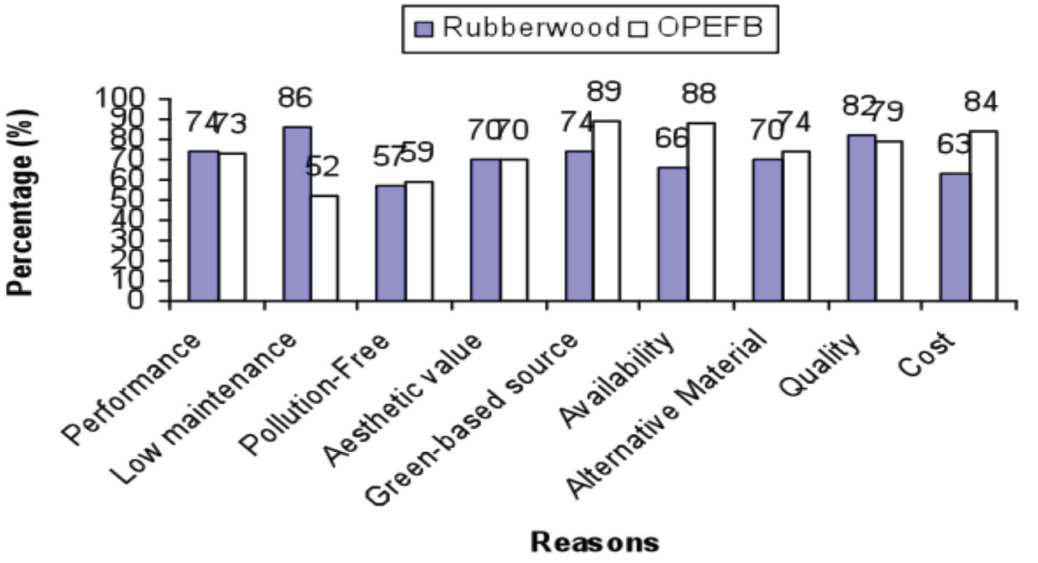
Based on the analysis of the questionnaire, 97% of the manufacturers chose rubberwood as the most accepted material for producing wood-based products. This indicated that majority of the manufacturers chose rubberwood as the best raw material. The other group of manufacturers agreed that *jelutong* and *sesenduk* are better as input materials for wood-based products. As rubberwood was found to be the most accepted material, it was therefore chosen to be compared with OPEFB in the 'reasons of acceptance' analysis. The results of the comparison are illustrated Figure 1. Surprisingly, OPEFB was found to be superior to rubberwood in terms of cost-effectiveness, good alternative material,

availability, better green-based source, and pollution-free. OPEFB was found to have a similar value with rubberwood for being chosen due to its aesthetic value. Rubberwood, on the other hand, was found incomparable for its performance, maintenance ability and quality. This analysis clearly showed greater confidence obtained by OPEFB from the manufacturers as compared to rubberwood. This finding further leads to the following question: If the manufacturers are very confident with OPEFB, why do they still prefer rubberwood as a raw material for their products? The answer to this question can be found under the 'market segment' section, which explains the influence of demand.

Market Segment

The market segment was dominated by home furniture sector, followed by office furniture, table set, bed room set, education table, cabinet, kitchen, phone table, wooden door, and others. The percentage of each market segment is exhibited in Fig.2.

The percentage of the market segment also explains the pattern in the demands for those wood-based products. This means a higher percentage of the market segment indicates a higher demand. Based on the data given in Fig.1, home furniture receives the highest demand, which indirectly encourages manufacturers to utilize the accepted alternative raw materials for producing home furniture. This is probably the reason for the higher acceptance level



*The mean values for each parameter of each raw material were found insignificant

Fig.1: Acceptance reasons for rubberwood and OPEFB.

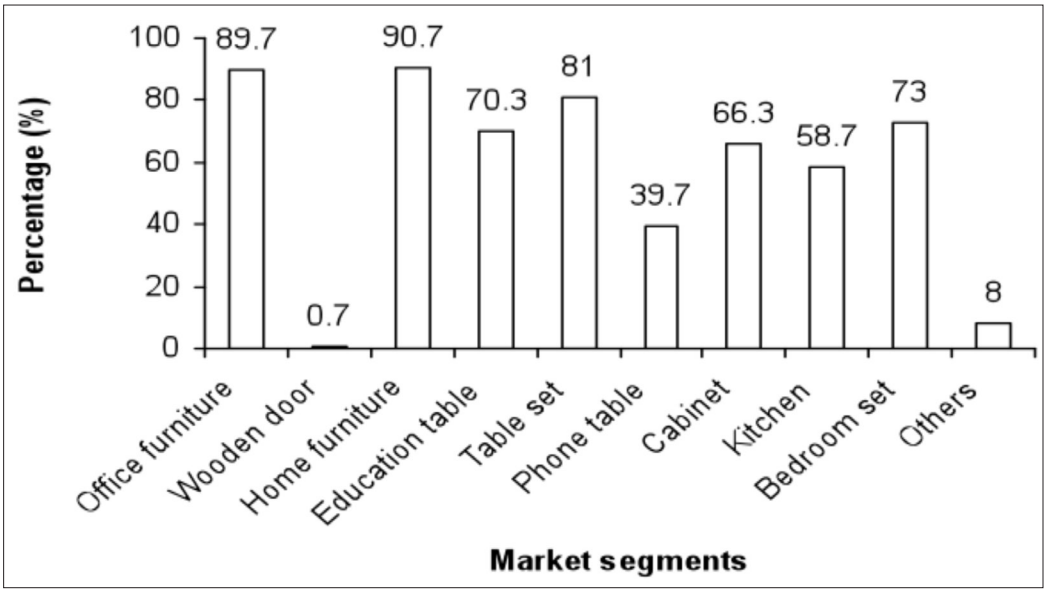


Fig.2: Percentage of the market segments

for rubberwood compared to OPEFB, even though OPEFB has greater manufacturers' confidence (refer to the 'reasons of acceptance').

Awareness towards OPEFB Particleboard

In response to the awareness towards OPEFB particleboard, the manufacturers were found be aware of the existence of this particular material in the industry. According to them, OPEFB particleboard is available and gradually replacing rubberwood-based particleboard as an alternative raw material for the production of wood-based products. This is probably due to the demand of rubberwood that has overshadowed its supply and caused its price to increase and eventually burdened most manufacturers and encouraged the manufacturers to switch to OPEFB (Paridah *et al.,* 2009). The manufacturers aware that OPEFB particleboard is frequently used for production of home furniture (awareness score: 4.9), followed by office furniture (awareness score: 4.7), cabinets (awareness score: 4.7), tables and kitchens (awareness score: 4.5), chairs (4.4) and doors (3.1). Once again, the manufacturers agreed that the awareness level was influenced by the consumers' demands.

Preferred Particleboard Attributes

Before promoting the use of OPEFB particleboards among manufacturers, it is crucial to know the kind of particleboard attributes that are preferred by manufacturers and customers (refer to Table 3, under OPEFB Particleboard Attributes and availability). As shown, there were insignificant differences between the parameters studied. This further indicates that all the presented attributes are very

TABLE 5
Correlation Matrix of the Characteristics of Rubberwood Particleboard

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A1	1.00									
A2	0.09	1.00								
A3	0.02	-0.22	1.00							
A4	0.01	0.39	-0.04	1.00						
A5	-0.05	-0.20	0.03	-0.33	1.00					
A6	0.07	-0.17	0.15	0.02	-0.13	1.00				
A7	-0.07	-0.12	-0.15	-0.18	-0.08	-0.26	1.00			
A8	0.14	0.53	-0.07	0.19	-0.12	-0.10	-0.18	1.00		
A9	-0.07	-0.24	-0.02	-0.08	0.01	-0.04	0.04	-0.39	1.00	
A10	0.01	0.41	-0.01	0.12	-0.14	-0.05	-0.07	0.21	-0.24	1.00

A1: Acceptance Level, A2: Performances, A3: Low Maintenance, A4: Pollution Free, A5: Aesthetics, A6: Green Based Resources, A7: Availability, A8: Alternative Material, A9: Quality, and A10: Cost

TABLE 6
Correlation Matrix of the Characteristics for OPEFB Particleboard

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A1	1.00									
A2	-0.02	1.00								
A3	0.02	-0.40	1.00							
A4	0.06	-0.12	-0.11	1.00						
A5	-0.07	0.01	-0.08	-0.21	1.00					
A6	0.10	-0.09	0.02	-0.10	0.02	1.00				
A7	0.09	-0.17	0.09	-0.11	-0.01	-0.03	1.00			
A8	-0.09	-0.05	-0.11	-0.19	0.83	0.09	-0.02	1.00		
A9	-0.09	0.18	-0.04	-0.20	0.03	-0.16	-0.14	0.01	1.00	
A10	0.08	-0.07	0.04	0.07	-0.23	-0.01	0.04	-0.26	-0.16	1.00

A1: Acceptance Level, A2: Performances, A3: Low Maintenance, A4: Pollution Free, A5: Aesthetics, A6: Green Based Resources, A7: Availability, A8: Alternative Material, A9: Quality, and A10: Cost.

important for the manufacturers. The ratings of the attributes were cost (4.52), tooling (4.45), aesthetic value (4.44), porosity (4.39), surface smoothness and uniformity (4.35), veneer and laminate adhesions (4.34), moisture resistance (4.31) and screw and staple holding ability (4.30). Cost is shown to be the most important attribute in producing particleboard. Therefore, to make OPEFB one of the favourite materials among the manufacturers, it has to fulfil all the attributes rated by them. Unfortunately, like other materials, OPEFB also possesses certain weaknesses. According to the manufacturers, OPEFB particleboards have poor surface uniformity and smoothness,

low moisture resistance that causes fibre to swell and destroy paints, veneers and laminates do not adhere properly, low screw and staple-holding ability and are too hard on tooling. Nonetheless, they also agreed that OPEFB particleboards are much more cost effective than rubberwood-based particleboards.

Environmental Issues

Some important environmental issues that have encouraged the manufacturers to switch to alternative materials (instead of using solid wood of natural forests) are presented in Fig.3.

From the figure, three top environmental issues for the manufacturers were searching for green products (98.3), reforestation (96.3) and the use of waste (95.7). Based on the characteristics of the OPEFB, this material can be undoubtedly declared as an 'environmental-friendly' material. OPEFB is abundantly available as a waste which can be fully utilized for substituting solid wood, and this may help in reducing the heavy reliance on natural forests for continuous supplies of raw materials for the industry. The advantage of the OPEFB may also fulfil the requirements for it to be awarded as a green-product. If these are the advantages that the manufacturers are looking for, then OPEFB particleboards will definitely be preferred, and this can thus enhance the opportunity of OPEFB particleboards to penetrate the wood-based products market.

Respondents' Perception of OPEFB Particleboards

The highest rated perception towards OPEFB particleboard was the 'lack of information about the panel' (98.6%). Thus, to form good market coverage for OPEFB particleboards, it is essential to change this perception. Users' and manufacturers'

TABLE 7
Mean and Standard Deviations of the Characteristics of Rubberwood Particleboard

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Mean	4.90	0.74	0.86	0.57	0.70	0.74	0.66	0.46	0.82	0.63
SD	0.35	0.44	0.35	0.50	0.46	0.44	0.47	0.50	0.39	0.48

A1: Acceptance Level, A2: Performances, A3: Low Maintenance, A4: Pollution Free, A5: Aesthetics, A6: Green Based Resources, A7: Availability, A8: Alternative Material, A9: Quality, and A10: Cost

TABLE 8
Mean and Standard Deviations of the Characteristics of OPEFB Particleboard

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Mean	3.64	0.73	0.52	0.59	0.70	0.89	0.88	0.74	0.79	0.84
SD	0.89	0.44	0.50	0.49	0.46	0.31	0.32	0.44	0.41	0.37

A1: Acceptance Level, A2: Performances, A3: Low Maintenance, A4: Pollution Free, A5: Aesthetics, A6: Green Based Resources, A7: Availability, A8: Alternative Material, A9: Quality, and A10: Cost

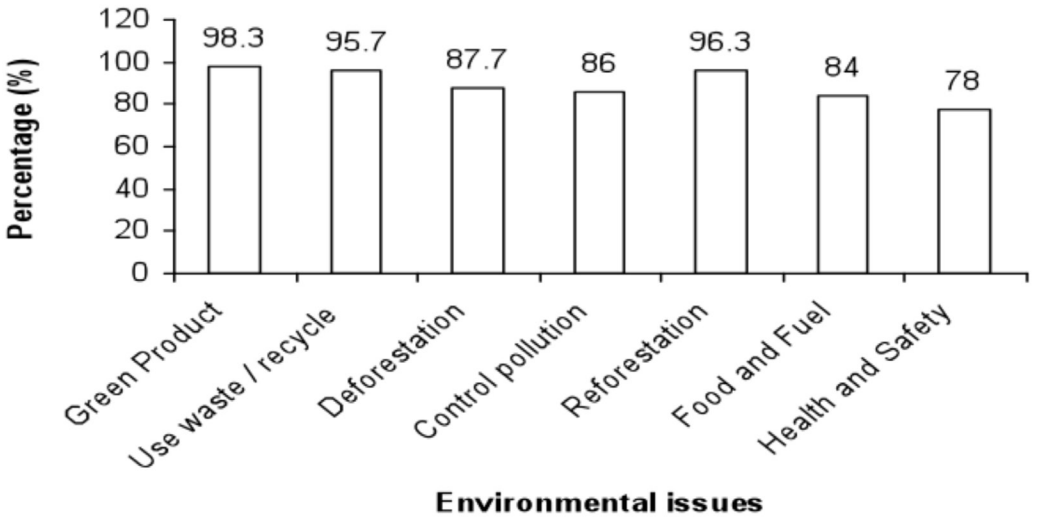


Fig.3: Environmental Issues

lack of information may limit the use of OPEFB particleboards. Hence, promotions introducing OPEFB particleboards should be carried out as soon as possible, and this needs to be done while the manufacturers are still searching for alternative materials with the intention to replace solid wood. The second highest rated perception was that OPEFB particleboards are much cheaper (97.7%) and more environmental-friendly (95.3%) than wood-based particleboards. It is because OPEFB particleboards are fabricated from wastes, which involve no high cost and are also environmental-friendly. These perceptions seem to provide a good chance to form a market for OPEFB particleboards as most manufacturers are looking for cost effective material (refer to the preferred particleboard attributes) and green product (refer to environmental issues) for their productions. Seventy six percent and seventy one percent of the manufacturers felt that OPEFB incurred low cost and possessed good physical and mechanical performances. Some manufacturers, however, thought that OPEFB was not suitable to be used in furniture and household applications due to its bad performances and low cost compared to the conventional particleboards.

Therefore, among the suggestions that can be given to the manufacturers to help them improve their OPEFB-based products and form a wide market are: (1) OPEFB particleboard manufacturers must address some of the major technical problems mentioned by many of the respondents (such as surface smoothness, aesthetics, moisture, etc.) prior to entering the competitive furniture and door markets; (2) OPEFB particleboard manufacturers should emphasize the product's advantages (namely, strength, dimensional stability, etc.), and ensure that all consumers are

aware of these by having brochures and fact sheets in furniture and door outlets.

Correlation Matrix for Particleboards

Tables 5 and 6 show the correlation matrix for the characteristics of rubberwood particleboard and OPEFB particleboard manufacturers, respectively. The correlation coefficient values were found to range between -0.39 and 0.53 for rubberwood particleboards, and -0.40 and 0.83 for OPEFB particleboards. The highest correlation in the matrix for rubberwood was 0.53, between the characteristics of the performances and alternative materials, while the lowest was -0.39, which was between the characteristics of the alternative materials and quality. For OPEFB particleboards, the highest correlation in the matrix was 0.83, i.e. between the characteristics of aesthetics and alternative materials, while the lowest was -0.40, i.e. between the characteristics performances and low maintenance. These correlations were strong enough to justify the analysis.

On the contrary, the correlations between the variables of low maintenances, pollution free, quality and cost were found to be negative, while all the other correlations were positive for OPEFB particleboards. These correlations show that most manufacturers disagreed with these statements.

Tables 7 and 8 reveal that the means of most characteristics were quite low for rubberwood particleboards and OPEFB particleboards, suggesting that in most cases, the respondents have accepted particleboards as a premier furniture material. In particular, the respondents mostly disagreed in term of the acceptance level of the OPEFB particleboard characteristics, based on their previous research and knowledge. The deviation in the characteristics indicated a general consensus among the consumers. The lowest value of deviation for this study was performance, and this indicated that consumers strongly agreed that OPEFB particleboard was a good material for furniture and doors. According to Ratnasingam and Wagner (2009), people strongly agreed that particleboard-based furniture is perceived to incur low cost, but consumers disagreed on other characteristics such as its machining, attractiveness, dimensional stability, uniform thickness and warp free.

CONCLUSIONS

The findings of this study have clearly revealed that manufacturers and users (respondents) of wood-based products have various opinions towards the alternative material that has recently been introduced with intention to reduce the usage of solid wood, which may eventually reduce deforestation. Most of the respondents still preferred rubberwood as the best raw material for the production of wood-based products due to its acceptable physical and mechanical properties. Meanwhile, OPEFB is still in the initial stage of gaining manufacturers' confidence but is in its way to overtake the popularity of rubberwood. Various promotions on OPEFB as an input for wood-based products should be seriously

done in order to increase its acceptance level among the respondents as they were actually not aware with the existence of the material. The main reasons of the low acceptance level indicated for OPEFB and OPEFB particleboards were the lack of information about the material and products. OPEFB particleboard is presently utilized as a non-used material in the manufacturing industry. In order to penetrate market places, specific target markets and technical strategies must be undertaken.

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